3.1 EARTH

3.1.1 Existing Conditions

3.1.1.1. Regional Geography and Prominent Features

The proposed Wild Horse Wind Power Project (Project) is located in the northeast portion of Kittitas County in central Washington. Comprising a geographic area of 5,978 square kilometers (2,308 square miles), Kittitas County ranks eighth in size among Washington counties. The county is located east of the Cascade Range in the geographical center of the state and is bounded to the north by Chelan and Douglas Counties, to the south by Yakima County, and to the east by Grant County. The Pacific Crest Trail, high in the Cascade Range, forms its boundary to the west with King County. Prominent geographic features in Kittitas County include the Yakima River and Kittitas Valley to the southwest of the Project, the Wenatchee Mountains to the northwest, the Cascade Mountains to the far west, and the Columbia River to the east. The immediate Project area is dominated by northwest-southeast trending ridges that gently slope between elevations of 3,000 to 3,800 feet, and Whiskey Dick Mountain at approximately 3,873 feet. These ridges are generally dry and wind blown and support short shrub steppe vegetation.

The terrain in the county's northwest corner is in the southern extension of the Wenatchee National Forest and consists of rugged and heavily forested wilderness. At higher elevations, a series of major rivers carries precipitation and snow-melt out of the Cascades and into the Kittitas Valley. The Cooper and Waptus Rivers feed into the Cle Elum River while the North, West, and Middle Forks of the Teanaway River converge and become the main stem of the Teanaway River. Descending out of the mountains, the Cle Elum and Teanaway Rivers then feed into the Yakima River, which flows across the remaining expanse of Kittitas County (including Ellensburg) before winding south into Yakima County. The eastern portion of Kittitas County is bounded by the Columbia River. Near the eastern end of the Wenatchee Mountains, Naneum Ridge generally runs north-south through the Project area, and provides a drainage divide for numerous creeks and ephemeral springs flowing either west into the Yakima River, or east into the Columbia River.

The Wenatchee Mountains extend from the Cascade Range and include Naneum, Caribou, and Whiskey Jim Creeks, all of which eventually join the Yakima River south of Ellensburg. Skookumchuck and Whiskey Dick Creeks are included in surface waters that flow eastward into the Columbia River. To the south, the Saddle Mountains and the Manastash and Umtanum ridges are a physical barrier that runs east and west to form the county's southern border with Yakima County.

A brief description of surrounding land use and designations of the Project facility locations in applicable land use plans and zoning ordinances is located in Section 3.10.1, ‘Existing Conditions’. Section 3.2.1, ‘Existing Conditions’ describes climatological features at the Project site.

3.1.1.2. Geology

Regional Geology and Typical Geological Features

The Project area is located on the Columbia Plateau, which is located at the eastern base of the Cascade Range, and at the western edge of the Columbia Intermontane Physiographic Province (Freeman and others, 1945). This lowland province is surrounded on all sides by mountain ranges and highlands, and covers a vast area of eastern Washington and parts of northern Oregon. The province is characterized by moderate topography incised by a network of streams and rivers that drain towards the Columbia River.

The Columbia Plateau is underlain by a series of layered basalt flows extruded from vents (located mainly in southeastern Washington and northeastern Oregon) during the Miocene epoch (between 7 and 26 million years before present (B.P.). Collectively, these basalt flows are known as the Columbia River Basalt Group. Individual basalt flows range in thickness from a few millimeters to as much as 300 feet.

A variety of sedimentary units that range from Pliocene (2 to 7 million years B.P.) to Holocene (less than 10,000 years B.P. in age) are interbedded and overlie the Columbia River Basalt Group. Along the borders of the plateau, the basalts are underlain by Precambrian (more than 570 million years B.P.) to early Tertiary (65 million years B.P.) rock, which is mostly volcanic and metamorphic in origin. Sedimentary rocks are generally thought to underlie the basalts in the Project area (USGS, 2000).

The Columbia Plateau was divided into three informal physiographic subprovinces by Myers and Price (1979): the Yakima Fold Belt, Blue Mountains, and Palouse subdivisions.

Local Geology

The Project site is located in the Yakima Fold Belt subprovince; an area that includes most of the western half of the Columbia Plateau north of the Blue Mountains. Structurally, the Yakima Fold Belt subprovince is characterized by long, narrow anticlines with intervening narrow to broad synclines that trend in an easterly to southeasterly direction from the western margin of the plateau to its center. Most major faults are thrust or reverse faults that strike subparallel to the anticlinal fold axes. These faults are probably contemporaneous with the folding. Northwest- to north-trending shear zones, and minor folds commonly transect the major folds (USGS, 2000).

Exhibit 6-A and 6b contain maps which illustrate the major geologic units and features discussed in this section.

Structural Geology:

The structural geology of the site primarily includes folded and dipping basalt beds. The Whiskey Dick Anticline trends east-southeast through Whiskey Dick Mountain. The south-trending Naneum Ridge Anticline extends along the western edge of the Project site and intersects the Whiskey Dick Anticline atop Whiskey Dick Mountain. An east-dipping monocline is mapped just east of the Project area. The basalt beds in the eastern side of the Project site dip up to 6 degrees eastward, towards the Columbia River. See Exhibit 6-A, 'Geologic Units and Faults Map' and Exhibit 6-B, ‘Geologic Structures and Faults Map (25 mile radius)'.

A landslide is mapped on the south side of Whiskey Dick Mountain. This slide was observed during the site visit. This landslide is estimated to be approximately 1/3 square mile in area and almost a mile long. The elevation ranges from approximately 3000 feet to 3700 feet over the length of the slide, with a corresponding average ground slope of approximately 2 horizontal to 1 vertical. The surface of this landslide is irregular and hummocky, and at the time of the site visit, springs appeared to be emanating from some portions of the slide. Native vegetation was observed at the surface throughout the slide area, suggesting that activity on the slide was either historical, or is of a rate slow enough to enable the establishment of native vegetation. This slide is mapped near C and D strings. (Tabor et. al, 1982). The location of this slide is indicated in the map provided in Exhibit 4, ‘Geotechnical Data Report’. Further discussion pertaining to this feature is included in Section 3.1.2.4, ‘Soils’.

As noted in Exhibit 6-B, two faults are mapped in the southeast area of the Project, that run approximately parallel to and on either side of the Whiskey Dick Anticline (which approximately follows the layout of the G string). Several other faults are noted approximately 5 miles west of the Project, which also trend northwest-southeast. These faults offset Miocene-age formations, and are mapped as being concealed beneath Quaternary formations (Tabor et al., 1982). This indicates the faults in the Project vicinity are older than Quaternary age, and likely formed in late Miocene age (between 6 and 18 million years ago). Many of these faults are inferred and shown as dotted lines buried by alluvial fan materials. It appears that these faults are inferred based on scattered outcrops of bedrock in the alluvial fans. If the faults had moved after the deposition of the alluvial fans, the alluvial fans would have been offset and that would have been an indication that these faults had been active in the late Quaternary.

Bedrock:
The bedrock underlying the Project site consists of Miocene-age basalt flows, and includes the upper Grande Ronde Basalt and the Frenchman Springs Member of the Wanapum Basalt, with interbedded Ellensburg Formation.

The upper Grande Ronde Basalt is described as fine- to medium-grained, nonporphyritic to very sparsely plagioclase porphyritic. Magnetic polarity is normal in the upper part of the Grande Ronde Basalt, but reversed in the lower part of the formation. Based on observations of outcrops and test pits during the site visit, the Grande Ronde Basalt appeared to be dark gray, fine-grained, and very hard but was fractured into angular to subrounded cobbles within a few feet of the ground surface. The fractured portion was infilled by silty and sandy matrix. In most of the test pits excavated in this basalt, the upper few feet were fractured and rippable, but fracture spacing and rock mass quality increased downward rapidly. Most test pits were terminated within 3 feet of the ground surface and were unable to be excavated further by the backhoe.

The Frenchman Springs Member is mapped in the Project area north of Whiskey Dick Mountain and overlies the Grande Ronde Basalt. This unit is described as fine- to medium-grained basalt with abundant to sparse plagioclase phenocrysts and glomerocrysts, commonly 1 to 2 cm across, irregularly distributed throughout the flow, and with normal magnetic polarity. Based on observations of outcrops and test pits excavated during the site visit, the Frenchman Springs member was similar in characteristics to the Grande Ronde Basalt, and is dark gray, fine-grained, and very hard but fractured. The fractured portion was infilled by silty and sandy matrix. In most of the test pits excavated in this basalt, the upper few feet were fractured and rippable, but fracture spacing and rock mass quality increased downward. Most test pits were terminated within 2 to 3 feet in depth and were unable to be excavated further by the backhoe.

A localized outcrop of the Vantage Member of the Ellensburg Formation is mapped in the southeast portion of the Project area. This unit consists of interbedded, weakly-cemented, volcaniclastic sandstone, siltstone, and minor dark mudstone. This member occurs between the Grande Ronde and Wanapum basalts, has an average thickness of 16 to 33 feet, and pinches out to the west towards the Naneum Ridge anticline. Based on observations and documentation of springs in the Project site, it appears that the springs are generally located along a relatively horizontal low-permeability zone that likely correlates with the Vantage Member.

Unconsolidated Deposits:
No unconsolidated deposits are mapped in the Project vicinity on the geologic map except for the landslide discussed above. Based on observations made during the site visit, the surficial materials consist primarily of a thin veneer of brown, silty clay topsoil that was likely wind-deposited. The thickness of this material varies across the site from a few inches to three feet, based on test pit observations. In several areas bedrock and talus were observed at the ground surface.

Mineral Resoureces:
Mineral resources in the immediate vicinity of the Project site include a small inactive borrow pit near the northwest corner of the site. Impacts to local geologic resources would be limited to rock excavated during wind turbine foundation construction activities and gravel quarrying for construction. Earth materials disturbed during excavation activities are not considered significant geologic resources, and therefore, impacts to local geologic resources would be negligible.

<u>*Historical Seismicity and Earthquake Risk & Probability*</u>
The seismic hazards in the region result from three seismic sources: interplate events, intraslab events, and crustal events. Each of these events have different causes, and,

therefore, produce earthquakes with different characteristics (that is, peak ground accelerations, response spectra, and duration of strong shaking).

Intraslab and Interplate Events:
Two of the potential seismic sources are related to the subduction of the Juan De Fuca plate beneath the North American plate. Interplate events occur as a result of movement at the interface of these two tectonic plates. Intraslab events originate in the subducting tectonic plate, away from its edges, when built-up stresses in the subducting plate are released. These source mechanisms are referred to as the Cascadia Subduction Zone (CSZ) source mechanism. The CSZ originates off the coast of Oregon and Washington, with subduction occurring beneath both states. The two source mechanisms associated with the CSZ currently are thought to be capable of producing moment magnitudes of approximately 9.0 and 7.5, respectively (Geomatrix, 1995).

Crustal Events:
Earthquakes caused by movements along crustal faults, generally in the upper 10 to 15 miles, result in the third source mechanism. In Washington, these movements occur in the crust of the North American tectonic plate when built-up stresses near the surface are released. According to the Washington Division of Geology and Earth Resources (WDGER), all earthquakes recorded in eastern Washington have been shallow, with most measured at depths less than 3.7 miles. The largest earthquake in eastern Washington in the last 50 years was a shallow, magnitude 4.4 event northwest of Othello on December 20, 1973 (WDGER, 2002).

Local Faults:
As noted in Exhibit 6-B, , two faults are mapped in the southeast area of the Project, that approximately run parallel to and on either side of the Whiskey Dick Anticline (which approximately follows the layout of the G string). Several other faults are noted approximately 5 miles west of the Project, which also trend northwest-southeast. These faults offset Miocene-age formations, and are mapped as being concealed beneath Quaternary formations (Tabor et al., 1982). This indicates the faults in the Project vicinity are older than Quaternary age, and likely formed in late Miocene age (between 6 and 18 million years ago). Based on the low level of historical seismicity and lack of late-Quaternary offsets of local deposits, the faults in the Project vicinity are likely inactive or else active but typically produce events with magnitude less than 3.0. Based on this information, local faults are not considered to pose a significant hazard to the proposed Project and further investigation or other mitigation measures are not warranted.

Historical Seismic Events in the Project Region:
Three earthquake databases managed by the U.S. Geological Survey list seismic events that have occurred within 60 miles of the Project site (USGS, 2001a). The databases searched were, “USGS/NEIC 1973-Present,” “Significant U.S. Earthquakes (1568-1989),” and “Eastern, Central, and Mountain States of U.S., 1534-1986.” These searches identified 73 seismic events of varying magnitudes and intensities that occurred between 1887 and 2000. Table 3.1.1-1 identifies only those seismic events that meet the following criteria:

- Magnitude and/or intensity data are available;
- The magnitude of the event is 3.0 or higher;
- The intensity using the Modified Mercalli (MM) Intensity Scale of the event is III or higher, or the event was actually "felt." For reference, an intensity of MM III is associated with shaking that is "felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake" (USGS, 2002). In comparison an event with an intensity of MM VII would produce the following effects: "Damage negligible in building of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken. Noticed by persons driving motor cars."(USGS, 2002);
- The seismic event was not an aftershock associated with a larger quake at the same location.

TABLE 3.1.1-1Historical Seismic Events That Have Occurred Within 60 Miles[1] of the Project Site[2]

Year	Month	Day	Latitude (° North)	Longitude (° West)	Magnitude[3]	Intensity[4]	Distance (miles)
1872	12	15	47.90	120.30	7.0	IXF	57
1959	8	6	47.82	120.00	4.4	VIF	52
1973	12	20	46.94	119.25	4.8	F	44
1974	7	14	47.60	120.70	3.3	IVF	43
1975	6	28	46.24	119.71	3.7	--	58
1977	7	13	47.06	120.96	3.6	VF	34
1978	6	27	46.86	120.96	3.7	IIF	36
1979	7	28	46.66	120.66	3.1	IVF	32
1979	12	10	46.70	120.60	3.2	VF	29
1981	2	2	46.28	120.88	4.0	--	59
1981	2	18	47.21	120.90	4.2	VIF	34
1983	11	14	46.66	120.57	3.1	IIIF	30
1983	12	5	46.93	120.70	3.3	VF	23
1984	4	11	47.54	120.16	3.6	--	34
1985	1	9	47.06	120.06	3.2	--	7
1985	6	17	47.06	120.05	3.3	--	7
1987	6	11	46.82	120.59	3.0	--	22
1987	12	2	46.67	120.68	4.1	VF	32
1987	12	2	46.68	120.67	4.3	IVF	32
1988	2	6	47.67	120.02	3.0	F	43
1988	5	5	47.65	120.32	3.3	IIIF	41
1988	5	28	46.81	119.43	3.5	--	38
1988	7	9	46.84	119.69	3.7	--	27
1988	7	14	46.89	119.41	3.3	--	37
1990	3	1	47.77	120.96	3.1	--	59

TABLE 3.1.1-1Historical Seismic Events That Have Occurred Within 60 Miles[1] of the Project Site[2]							
Year	**Month**	**Day**	**Latitude (° North)**	**Longitude (° West)**	**Magnitude[3]**	**Intensity[4]**	**Distance (miles)**
1990	4	22	46.54	119.73	3.3	--	40
1990	6	19	46.84	119.32	3.3	--	43
1990	12	15	46.80	119.99	3.1	--	19
1990	12	22	46.80	119.99	3.4	--	19
1991	2	1	46.81	120.56	3.4	--	22
1991	2	22	46.87	120.65	3.2	--	23
1991	2	26	46.72	119.88	3.0	--	26
1991	3	28	47.68	120.33	3.3	IVF	43
1991	7	6	46.94	120.34	3.4	--	9
1991	7	7	46.93	120.34	3.3	--	9
1991	11	24	47.60	120.24	3.2	--	37
1992	1	24	47.66	120.13	3.4	IIIF	41
1992	10	26	46.86	120.72	3.5	VF	26
1994	4	1	47.66	120.14	3.0	F	41
1994	6	25	46.87	119.31	3.0	--	43
1994	8	7	47.66	120.17	3.1	--	41
1994	11	13	46.59	119.59	3.3	--	41
1995	1	13	46.58	120.71	3.2	--	38
1995	3	9	47.19	120.95	3.0	--	35
1995	6	30	47.11	120.5	3.0	--	14
1995	8	29	46.21	119.91	3.1	--	57
1995	12	17	47.60	120.22	3.1	--	37
1996	6	25	47.20	119.51	3.0	--	33
1997	1	1	46.77	120.46	3.7	--	21
1997	5	27	46.83	119.36	3.3	--	41
1997	7	4	47.72	120.02	3.6	--	46
1997	9	3	47.69	120.27	3.3	--	43
1997	9	18	47.69	120.02	3.3	--	44
1997	11	6	46.53	119.71	3.3	--	40
1999	9	19	46.44	119.63	3.1	--	48
1999	9	19	46.39	120.11	3.2	--	43
1999	12	25	47.63	120.2	3.0	--	39
2000	3	16	47.61	119.32	3.2	F	55
2000	12	24	47.74	120.28	3.5	IVF	47
2001	2	28	47.75	120.03	3.2	IIIF	48
2001	5	11	47.23	119.35	3.3	--	41
2002	6	6	47.72	120.29	3.4	F	45
2003	1	15	46.62	120.52	3.2	F	31

TABLE 3.1.1-1Historical Seismic Events That Have Occurred Within 60 Miles[1] of the Project Site[2]

Year	Month	Day	Latitude (° North)	Longitude (° West)	Magnitude[3]	Intensity[4]	Distance (miles)

[1] The approximate center of the Project site is located at latitude 47° 02' 23" N, longitude 120° 12' 42" W.

[2] Source: USGS Earthquake Hazards Program (see http://neic.usgs.gov/neis/epic/epic_circ.html).
The databases search includes Significant U.S. Earthquakes 1568 to 1989 and USGS/NEIC (PDE) 1973 - Present . The only earthquakes in the database prior to 1973 include events in 1872 and 1959.

[3] Magnitude values are calculated by the USGS. Magnitude values are Local Magnitudes(ML) and Coda Duration Magnitude (MD). LM magnitude is generally referred to as the true "Richter magnitude". The values are computed for distances less than 600 km with depths less than 70 km. MD estimates are derived from the duration or coda length of earthquake vibrations. Duration or coda length magnitude scales are normally adjusted to agree with ML (see http://neic.usgs.gov/neis/epic/code_magnitude.html).

[4] Modified Mercalli intensity scale. Dashed line equals no data for that event.

An earthquake magnitude of 5.5 to 6.0 was selected as being the dominating event at the Project site. The earthquake magnitude selected for the Project site was based on USGS deaggregation seismic hazard mapping for the Umatilla, Oregon, and Walla Walla, Washington, areas. These locations were selected as the closest locations with available data that are representative of the Ellensburg, Washington, area's seismology. The USGS seismic hazard maps present the average magnitude of all potential sources at a given location, and provide the percent contribution at discrete locations of the overall seismic hazard.

However, as shown in Table 3.1.1-1, seismograph records since 1959 indicate the Project area itself has been a-seismic in recent historical time. The closest recorded seismic event had an epicenter about 7 miles from the Project site and had a magnitude of 3.2, or MM intensity of III+. The largest recorded seismic event occurred 44 miles from the Project site and had a magnitude of 4.8. Seismic impact hazard is therefore deemed to be negligible

Low Project Site Seismic Hazard/Earthquake Risk:
The Project area is not considered susceptible to liquefaction or lateral spreading, because liquefaction and lateral spreading require loose, saturated soils. The Project site is underlain by bedrock well above the water table. In addition, the probability of a significant earthquake event occurring during the construction activities is extremely remote. Seismic impact hazard during construction is negligible. As noted above, the probability that the crustal faults in the region are active is relatively low, based on the low level of historical seismicity and lack of late-Quaternary offsets of local deposits, the

faults in the Project vicinity are likely inactive or else active but typically produce events with magnitude less than 3.0. Therefore, the potential for fault offsets during a large earthquake also appears to be low. Based on this information, local faults are not considered to pose a significant hazard to the proposed Project and further investigation or other mitigation measures are not warranted.

Building Code Seismic Requirements and Considerations:
The Project shall be designed and constructed for seismic events in accordance with the engineering standards in effect at the time of construction, which will be either Uniform Building Code (UBC) or International Building Code (IBC) requirements. Under Uniform Building Code (UBC), construction projects are designed for a peak ground acceleration (PGA) corresponding to a level in excess of the 10 percent probable value in a 50 year period which corresponds to a likelihood of once in approximately every 500 years. Under IBC, the maximum considered earthquake (MCE) corresponds to an event having a 2 percent probability of exceedance in 50 years (or a 2500-year return period). The UBC and IBC standards require that under the design earthquake the factors of safety, or resistance factors, are used in the design to exceed certain values. This factor of safety is introduced to account for uncertainties in the design process and to ensure that performance is acceptable. Application of these codes in the Project design will provide adequate protection for the Project facilities and ensure protection measures for human safety, particularly given the relatively low level of earthquake risk for the site.

Volcanic Hazards
Within the State of Washington, the USGS recognizes five volcanoes as either active or potentially active: Mount Baker, Glacier Peak, Mount Rainier, Mount Adams, and Mount St. Helens. In the last 200 years, only Mount St. Helens, which is over 80 miles distant from the Project site, has erupted more than once (USGS, 2000a). Impacts to the Project from volcanic activity could be either direct or indirect.

Direct impacts could include the effects of lava flows, blast, ash fall, and avalanches of volcanic products (Waldron, 1989). Indirect effects could include mudflows, flooding, and sedimentation (Waldron, 1989). Data accumulated as a result of the 1980 Mount St. Helens eruption indicate that the most likely effect would be ash fallout in the geographic region surrounding the Project site if one of the five regional volcanoes were to erupt.

In the event that a volcanic eruption would damage or impact Project facilities, the Project facilities would be shut down until safe operating conditions return. Section 4.6.10, ‘Volcanic Eruption’, addresses emergency plans for the Project in the event of a significant volcanic eruption.

3.1.1.3. Soils

Soils in the Project area along the ridgetops, where most construction will occur, primarily consist of complexes of shallow soils that formed in residuum weathered from basalt and loess. Ridgetop soils in this portion of the Project area (which includes the wind turbine locations) include the following series (USDA, 2002a):

- Rock Creek Series: The Rock Creek series consists of shallow and very shallow soils formed in residuum from basalt. Rock Creek Soils are on ridgetops and plateaus. They are well drained with slow to medium runoff and moderately slow permeability. Slopes are 0 to 70 percent with a lithic (bedrock) contact at 14 inches.

- Argabak Series: The Argabak series consists of very shallow soils formed dominantly in loess and residuum weathered from basalt with some glaciated areas also having glacial till on ridgetops, hillslopes, and benches. Slopes are 0 to 65 percent and depth to a lithic contact ranges from 4 to 12 inches. They are well drained with slow to very rapid runoff and moderately slow permeability. Associated soils are Whiskey Dick soils found on hillslopes and ridgetops with a thickness of 20 to 40 inches to bedrock. Whiskey Dick soils are clayey-skeletal, well drained with slow to very rapid runoff, and slow permeability.

- Vantage Series: The Vantage series consists of shallow soils formed in residuum and colluvium from basalt with additions of loess. Vantage soils are well drained with slow to very rapid runoff and moderately slow permeability. They are on plateaus, ridgetops, benches and hillslopes. Slopes are 0 to 45 percent and depth to lithic contact ranges from 4 to 12 inches.

As noted above, soils in the area are dominated by three major soil series: the Rock Creek, Argabak and Vantage series. According to the Natural Resource Conservation Service (NRCS), the Rock Creek series is well drained with slow to medium runoff and moderately slow permeability, while the Argabak and Vantage are both classified as well-drained with slow to very rapid runoff and moderately slow permeability (USDA, 2002a). Even though soil permeabilities are classified as low and the runoff potential ranges from slow to very rapid, it is anticipated that the erosivity of area soils would be mitigated by factors such as grade (i.e., the majority of soils that would be disturbed in the Project area are generally located on grades of 20 percent or less) and the fact that area soils are well-drained. Therefore, it is estimated that the erosiveness of native soils immediately underlying the Project would be in the "medium" range. However, the erosivity index pertains to *in situ* (i.e., undisturbed) soils. As a result, the erosiveness index is not directly applicable to soils that would be disturbed by Project construction activities, but rather to soils adjacent to the disturbed areas. Please refer to Exhibit 5 for the Site Soils map.

For more information on erosion and erosion control measures, please see Section 3.1.2, 'Impacts of the Proposed Action' below and Section 3.3.2, 'Impacts of the Proposed Action'.

3.1.1.4. Local Geography and Topography

The Wild Horse Wind Power Project is located approximately 13 miles east of Ellensburg, WA. The Project is proposed on the ridges and plateau northeast of Whiskey

Dick Mountain. Whiskey Dick Mountain is the most prominent topographic feature in the Project site, and trends west-southeast, whereas the ridges in the northeast portion of the Project trend in various directions. The proposed strings of wind turbines trend generally in a northwest-southeast direction on these ridges. The Project site and adjacent lands range in elevation from approximately 2,000 to 3,870 feet above mean sea level with ridges ranging from 3,000 to 3,873 feet. Basalt rock is at or near the surface in most locations of the Project site, and mantled by a relatively thin cover of overburden clayey and sandy soil.

The Project area covers approximately 8,600 acres of land, although the actual permanent footprint of the area occupied by all of the Project facilities is only 165 acres. With the exception of Whiskey Dick Mountain, much of the site is a relatively flat plateau with steep-sided drainages eroded into it. Ephemeral and spring-fed creeks flow primarily eastward from the Project into the Columbia River. Exceptions are Dorse Spring and a spring in the south part of the Project area that flow south and west, draining into the Yakima River. Most of these drainages originate at springs that exist approximately between elevations 3,300 and 3,400 feet above mean sea level. Slopes within the Project area generally range from less than 5 degrees on the flat plateau area and ridge lines, up to 40 degrees on Whiskey Dick Mountain and in side drainages. Exhibit 1-B, 'Project Site Layout', presents a topographic map of the Project site.

<u>*Unique Physical Features*</u>

Lanslide:
In the south portion of the Project area, spanning Sections 32 and 33, a landslide is mapped. The direction of movement of this landslide is to the south, away from the Project site. A more complete description of this landslide is given above in Section 3.1.1.2, 'Geology'.

Benches:
Along sideslopes in the Project area, several areas of continuous, relatively horizontal benches were observed. These benches consist of an area approximately 20 to 40 feet wide where the ground surface was observed to be slightly flatter than the slope above and below the bench. There appear to be at least two different elevations at which these benches were observed. The uppermost bench was observed on the north and south sides of Whiskey Dick Mountain at an approximate elevation of 3,700 feet. Another set of these topographic benches were observed at various locations in the eastern area of the Project, at elevations between 3,300 and 3,400 feet. This second set of benches appears to coincide with the elevation of most of the known springs and seeps within the Project. These benches are believed to coincide with an interbed of subsurface material between basalt flows that has weathered and sloughed at the ground surface, and that cannot stand at as steep a slope as the basalt. The lower interbed is at a similar elevation as the Vantage Member of the Ellensburg formation, which is mapped only in the southeast area of the Project on the Wenatchee Geology Map (Tabor et al., 1982).

Other Features:

No petrified wood deposits similar to the gingko deposits located in the Gingko Petrified Forest (approximately 5 miles east of the Project site) have been discovered at the Project site and no petrified gingko was observed during the geotechnical reconnaissance work at the Project site.

No other unusual physical features were observed within or near the Project site. In the unlikely event that unique physical or geological features were discovered on-site during construction, construction personnel would stop work at that location and notify the project manager. The project manager would immediately contact appropriate officials at the state historic preservation office to determine an appropriate response.

3.1.2 Impacts of the Proposed Action

3.1.2.1 Erosion/Enlargement of the Land area

Possible impacts to the geologic formations during construction include altering the landscape with minor cuts-and-fills for roadways and leveling and excavation for turbine foundations. Section 2.2.3, ‘Project Facilities’ contains additional information on foundation construction and associated erosion control measures.

Because the construction of roads, wind turbine foundations, and other Project facilities will be engineered, these facilities will be subject to the requirements of a National Pollutant Discharge Elimination System (NPDES) storm water construction permit and other pertinent construction and operation permits and pollution control regulations as described in Section 4.6, NPDES, and Section 3.3.2.1, ‘Surface Water Runoff/Absorption’. These sections provide a more detailed description of the materials, methods and approaches used as part of the BMPs for effective storm water pollution prevention and erosion control, as required by the regulations.

A detailed construction Storm Water Pollution Prevention Plan (SWPPP) will be developed for the Project to help minimize the potential for discharge of pollutants from the site during construction activities. The SWPPP will be designed to meet the requirements of the Washington State Department of Ecology General Permit to Discharge Storm water through its storm water pollution control program (Chapter 173-220 WAC) associated with construction activities and will be provided to EFSEC for review prior to construction.

The SWPPP will include both structural and non-structural best management practices (BMPs). Examples of structural BMPs could include the installation of silt curtains and/or other physical controls to divert flows from exposed soils, or otherwise limit runoff and pollutants from exposed areas of the site. Examples of non structural BMPs include management practices such implementation of materials handling, disposal requirements and spill prevention methods.

The SWPPP will be prepared, along with detailed Project grading plan design, by the Engineering, Procurement and Construction (EPC) Contractor when design-level topographic surveying and mapping is prepared for the Project site. Implementation of the construction BMPs will be carried out by the EPC Contractor, with supervision by the Project's resident Environmental Monitor who will be responsible for implementing the SWPPP.

Site-specific BMPs will be identified on the construction plans for the site slopes, construction activities, weather conditions, and vegetative buffers. The sequence and methods of construction activities will be controlled to limit erosion. Clearing, excavation, and grading will be limited to the minimum areas necessary for construction of the Project. Surface protection measures, such as erosion control blankets or straw matting, may also be required prior to final disturbance and restoration if the potential for erosion is high.

All construction practices will emphasize erosion control over sediment control through such activities as the following:

- Straw mulching and vegetating disturbed surfaces;
- Retaining original vegetation wherever possible;
- Directing surface runoff away from denuded areas;
- Keeping runoff velocities low through minimization of slope steepness and length; and
- Providing and maintaining stabilized construction entrances.

3.1.2.2 On-Site Rock Pit Geology

Three on-site rock pits have been identified for the Project and are described in Section 2.2.3.1 'Roads and Civil Construction Work' under the subheading 'On-Site Rock Quarries'.

Each rock quarry will have a disturbance footprint of approximately 5 acres and the depth will be approximately 10-20 feet depending on the type of rock encountered at each location. The quality of the (basalt) rock was observed to be relatively consistent at each of the locations, and the basalt hardness was field-estimated to be medium-strong to very-strong. Thickness of overburden was commonly less than 3 feet at the sites. While these sites are considered to have the potential for development, subsurface exploration will be conducted in order to identify the depth, breadth, and quality of the rock at each of the potential sites.

Due to the abundance of basaltic rock in the region, the relatively small size of the quarries (five acres) and shallow depth of the quarry sites (10 to 20 feet), it is unlikely that quarry operations will deplete or have an impact on the abundance and availability of basaltic quarry rock in the region.

Design specifications and further details for excavation, blasting and other activities associated with the removal and preparation of quarry materials for Project construction will be included in the Project's construction plans and specifications. This information will be provided to EFSEC for review and approval prior to the initiation of constuction activities.

A reclamation plan for the proposed rock quarries will be submitted to EFSEC for review and approval prior to construction.

As described in Section 2.6.2, ‘WDNR’, the Washington Department of Natural Resources has informed the Applicant that RCW 78.44.031 (17)(d)(i) exempts surface mining primarily for on-site construction, on-site road maintenance, or on-site landfill construction. The use of onsite gravel is allowed as a temporary construction use, provided that the pits are located on private land and do not sell material for unrelated offsite uses. Therefore, DNR surface mining permits SM8A and SM6 are not required for the Project gravel quarries.

3.1.2.3 Excavation and Fills

Based on preliminary calculations and depending on the type of turbine foundation design used, WTG excavations are anticipated to total approximately 186 cubic yards each, for a total of approximately 24,000 cubic yards. Approximately 50 % of excavated soils are anticipated to be re-used as backfill at foundations. The remaining 50% is expected to be too large for re-use. These larger cobbles will be crushed into smaller rock for use as backfill or road material. In the event that a net surplus of excavated material results from construction, those materials that cannot be used during construction would be utilized during reclamation activities at the rock quarry pits.

Estimated depths of cuts and fills for roads, trenches, and each substation(s);, are listed in Table 3.1.2-1 below. The estimations assume maximum volumes for the Project facilities and typical volumes for the type of wind turbines proposed for the Project:

Table 3.1.2-1: Estimated Depth of Cut and Fills

Feature	Estimated Depth of Cut and Fills
Roads	1 to 2 ft deep x 24 ft average width
Underground Trenches	3 to 4 ft deep x 6 ft average width
Substations	1 to 2 ft deep x 250 ft x 450 ft
Typical WTG Foundation	Excavation: 16 ft diameter x 25 ft deep = 186 cubic yards (backfilled)
Typical Turbine Crane Pad	1 to 2 ft deep x 30 ft x 100 ft

Specific criteria and methods for construction, locations and methods for handling any imported fill material have not been determined. Applicant will provide this information to EFSEC when available. Although no off-site disposal of any spoils is anticipated, the Applicant has permitted for soil import and export activity in the NPDES permit application (contained in Exhibit 8) in the unlikely event that any spoils can not be disposed of on-site.

Sand sources for the underground trench shading have not yet been identified but will most likely come from off-site. The quantities of sand and gravel required have been estimated and are quantified in Section 3.8, 'Natural Resources'.

3.1.2.4 Soils

<u>*Landslide Potential & Avoidance*</u>

Mapped Landslide:
It appears that most Project facilities would not be located on unstable slopes or landslide-prone terrain. The turbines are located on top of ridges, on relatively flat areas, and not on slopes. Therefore, sliding of the soil materials is not expected. However, a landslide is mapped on the south side of Whiskey Dick Mountain, as indicated on the map provided in Exhibit 4, 'Geotechnical Data Report' (also see Section 3.1.1.2, 'Geology'). The location of this slide and its mechanisms of behavior could affect final turbine locations in the vicinity of the C and D strings. Field observations in this area indicated hummocky, disturbed terrain and springs. At the present time, the distance separating wind turbines and their facilities (approximately 800 feet minimum) from the mapped landslide boundary appears to be adequate.

However, prior to construction of the Project, further detailed site investigations including ground penetrating radar (GPR) and geotechnical drilling shall be conducted as necessary to delineate the limits of the potential landslide area to ensure that the turbines are not placed in potentially unstable terrain and in order to provide final recommendations for minimum safe setback distances from slide areas.

General Landslide Risk:
In general, the Project is located in relatively low-gradient topography with a relatively thin veneer of soil that overlies basaltic bedrock. Therefore, risk of a landslide appears to be minimal overall, aside from the area of concern discussed in the above paragraph. Observations of the site conducted during the geotechnical investigation and geologic site reconnaissance indicate that potential landslide-prone terrain is not visually apparent on the Project site in the vicinity of the proposed wind turbines. If slope failure were to occur, the turbine strings are typically situated at a safe distance from steep slopes and the turbines and their associated foundation structures would not be affected.

In the event that roads are constructed below steep slopes (greater than 21 to 30 degrees), soil and rock from exposed overburden could fall on the road if the cut bank slope were to fail (i.e., during an earthquake or from seasonal freeze/thaw action and slope raveling). However, the proposed site layout does not include any roads below such steep slopes. The road that traverses the north side of Whiskey Dick Mountain was constructed with minor cuts and fills, but no areas of instability were observed during the site visit.

Furthermore, because Project access roads are used infrequently during operations, the risk associated with rock fall and/or slope movement to a vehicle and driver is low.

General Impacts to Soils
Impacts on Project area soils would be limited to areas disturbed by the construction activities. Impacts would consist of removal of topsoil and loss of soil permeability due to compaction within the footprint of the permanent facilities and in areas used for temporary construction activities (i.e., temporary staging areas and roads). Soils in disturbed areas would be susceptible to erosion from wind and storm water runoff. However, impacts to soils in disturbed areas are expected to be negligible because of the implementation of storm water pollution prevention Best Management Practices (BMPs) and mitigation measures implemented through site restoration activities.

Impacts to soils adjacent to disturbed areas are expected to be negligible because of the implementation of storm water pollution prevention Best Management Practices (BMPs) and site restoration activities.

Potential for Encountering Contaminated Soils
Applicant commissioned KTA of Seattle, WA to conduct a Phase I Environmental Site Assessment (ESA) of the property to be developed as part of the Wild Horse Wind Power Project. The objective of the ESA was to identify and characterize obvious or potential environmental concerns that may exist at the site. To accomplish this objective, a Phase I ESA was performed focusing on a review of environmental records, including information on the physical setting, historical use, and known environmental hazards near the Site. KTA performed a Phase I ESA in conformance with the scope and limitations of ASTM Practice E 1527. This assessment revealed no evidence of environmental impairment within the Project area. Based on these findings, it is not anticipated that any environmental contamination will be encountered during construction or operation of the Project. In the unlikely event that contaminated soils are encountered, Applicant will coordinate with appropriate personnel at Department of Ecology. Section 3.16.1.4, 'Miscellaneous', further describes procedures addressing the discovery of contaminated soils.

3.1.2.5 Topography

Impacts on topography in the area would be limited to the footprint of the Project facilities and roads. No Project-related impacts are expected to the topography of areas adjacent to the proposed facilities, since proposed facilities will be constructed at or near existing grade. The Project would alter the landscape with minor cuts-and-fills for roadways and leveling for wind turbine foundations. Table 3.1.2-1 describes the estimated depth of cut-and-fill activities. Each of the three proposed rock quarries will have a disturbance footprint of approximately 5 acres and the depth will be approximately 10-20 feet depending on the type of rock encountered at each location. The Applicant will implement Best Management Practices (BMPs) for erosion control and storm water pollution prevention during construction, and will implement BMPs during restoration activities at the rock quarries to minimize impacts on topography.

Specific details of topographic modifications will be provided to EFSEC when detailed engineering plans have been developed. Siting of the control measures will be determined by Project engineers after final design has been completed.

3.1.2.6 Comparison of Impacts of the Proposed Scenarios

All design scenarios will comply with relevant regulations and would require the development of an appropriate erosion control plan and implementation of erosion control best management practices (BMPs) during Project construction and operation.

All design scenarios under consideration address landslide potential and will implement appropriate avoidance setbacks from surfaces deemed unstable or unsafe upon further geotechnical investigation prior to construction.

Impacts on Project area soils for all scenarios would be limited to areas disturbed by the construction activities. All design scenarios will implement the use of storm water pollution prevention Best Management Practices (BMPs) and site reclamation activities.

There will be no significant change to topography resulting from any of the design scenarios under consideration.

Under the different design scenarios, there is no change to the length or width of Project components, including the roads, substations, O&M facilities, rock quarries, underground or overhead lines, permanent met towers, batch plant, or rock crusher. These components comprise the vast majority of acreage impacted by the Project, and because they remain unchanged under all scenarios, the total acreage and construction quantities are very similar under all scenarios. This is because the scenarios utilize a nearly identical layout, with greater or fewer WTGs along each string, but with the same beginning and end points for each string. The "permanently disturbed" acreage differs only by the different number of WTG foundations required, which is a very small percentage of the overall Project footprint acreage. The Large WTG Scenario utilizes larger foundations for a smaller number of WTGs while the Small WTG Scenario utilizes smaller foundations for a larger number of WTGs, yielding similar acreage requirements. The different acreages permanently disturbed under each scenario are detailed in Table 3.1.2-2 below. Project Site Layouts for the different scenarios are contained in Exhibit 1.

The construction impacts are also substantially similar under the different design scenarios. There is no significant change to peak and total earthmoving quantities, or to peak and total production volumes at the batch plant or rock crusher. This is because the Large WTG Scenario utilizes <u>larger foundations</u> for a smaller number of WTGs while the Small WTG Scenario utilizes <u>smaller foundations</u> for a larger number of WTGs. The overall excavation quantities for the Project for the different turbine scenarios vary by less than 10%. Gravel requirements vary by less than 1% under the different scenarios. The different natural resource requirements under each scenario are detailed in Table 3.8.2-1.

Table 3.1.2-2: Comparison of Area Impacts of the Proposed Scenarios			
	MOST LIKELY Scenario	**SMALL WTG Scenario**	**LARGE WTG Scenario**
	70.5 m Rotor	**60 m Rotor**	**90 m Rotor**
WTG Foundations - total acres	9.4	9.2	9.3
New Road acres	67	67	67
Major & Minor Improved Road acres	28	28	28
Road Turnaround acres	26	26	26
Substation acres	9	9	9
O&M building & parking acres	4	4	4
Rock quarry acres	15	15	15
Overhead collector line total acres	0.1	0.1	0.1
BPA & PSE Transmission feeder line total acres	0.3	0.3	0.3
Permanent Met Tower acres	0.3	0.3	0.3
Batch Plant acres	6	6	6
Total acres permanently disturbed	165	165	165

Notes
These estimates include reasonable contingency estimates
Truck turnarounds are estimated at 1 acre each
3 Substations estimated at 3 acres each
3 Quarries estimated at 5 acres each
Overhead collector line estimated at 250' spans and 10' x 10' pole disturbed areas
Transmission feeder lines estimated at 600' spans, two pole H frames, and 8' x 8' disturbed areas
Permanent Met towers estimated at 5 towers, 50' x 50' impacted area each
Underground collector trench considered a temporary disturbed area and not included here

3.1.3 Impacts of No Action Alternative

Under the No Action Alternative, the Project would not be constructed or operated, and the environmental impacts described in this ASC would not occur. The No Action Alternative assumes that future development would comply with existing zoning requirements for the Project area, which is zoned Commercial Agriculture and Forest and Range. According to the County's zoning code, the Commercial Agriculture zone is dominated by farming, ranching, and rural lifestyles, and permitted uses include residential, green houses and agricultural practices. Permitted uses in the Forest and Range zone include logging, mining, quarrying, and agricultural practices, as well as residential uses (Kittitas County 1991).

However, if the proposed Project is not constructed, it is likely that the region's need for power would be addressed by user-end energy efficiency and conservation measures, by existing power generation sources, or by the development of new renewable and non-renewable generation sources. Baseload demand would most likely be filled through expansion of existing, or development of new, thermal generation such as gas-fired combustion turbine technology. Such development could occur at conducive locations throughout the state of Washington.

A baseload natural gas-fired combustion turbine would have to generate 67 average MW of energy to replace an equivalent amount of power generated by the Project (204 MW at 33% net capacity). (An average MW or "aMW" is the average amount of energy supplied over a specified period of time, in contrast to "MW," which indicates the maximum or peak output [capacity] that can be supplied for a short period.) See Section 2.3, 'Alternatives'.

3.1.4 Mitigation Measures

3.1.4.1 Mitigation for Seismic Hazards

The Project shall be designed and constructed for seismic events in accordance with the engineering standards in effect at the time of construction, which will be either Uniform Building Code (UBC) or International Building Code (IBC) requirements. The UBC and IBC standards require that under the design earthquake the factors of safety, or resistance factors, are used in the design to exceed certain values. Application of these codes in the Project design will provide adequate protection for the Project facilities and ensure protection measures for human safety, particularly given the relatively low level of earthquake risk for the site.

The wind turbines are also fitted with vibration sensors which will detect large scale seismic events and shut the turbine down immediately.

3.1.4.2 Mitigation for Volcanic Hazards

In the event that a volcanic eruption would damage or impact Project facilities, the Project facilities would be shut down until safe operating conditions return. If an eruption occurred during construction, a temporary shut-down would most likely be required to protect equipment and human health. See Section 3.8 for detailed Emergency Plans.

3.1.4.3 Mitigation for Erosion

Erosivity of area soils would be mitigated by factors such as grade (i.e., the majority of soils that would be disturbed by the Project are generally located on grades of 20 percent or less) and the fact that area soils are well-drained.

A detailed construction Storm Water Pollution Prevention Plan (SWPPP) will be developed for the Project to help minimize the potential for discharge of pollutants from the site during construction activities. The SWPPP will be designed to meet the requirements of the Washington State Department of Ecology General Permit to Discharge Storm water through its storm water pollution control program (Chapter 173-220 WAC) associated with construction activities and will be provided to EFSEC for review prior to construction.

All construction practices will emphasize erosion control over sediment control through such activities as the following (described in detail in Section 3.3.2, 'Impacts of the Proposed Action'):

- Straw mulching and vegetating disturbed surfaces;
- Retaining original vegetation wherever possible;
- Directing surface runoff away from denuded areas;
- Keeping runoff velocities low through minimization of slope steepness and length; and
- Providing and maintaining stabilized construction entrances.

3.1.4.4 Mitigation for Landslides

In general, the Project is located in relatively low-gradient topography with a relatively thin veneer of soil that overlies basaltic bedrock. Therefore, risk of a landslide appears to be minimal overall. If slope failure were to occur, the turbine strings are typically situated at a distance from steep slopes and the turbines and their associated foundation structures would not be affected.

3.1.4.5 Mitigation for Unique Features

In the unlikely event that unique physical or geological features were discovered on-site during construction, construction personnel would stop work at that location and notify the project manager. The project manager would immediately contact appropriate officials at the state historic preservation office to determine an appropriate response.

3.1.4.6 Mitigation for Contaminated Soils

Applicant commissioned KTA of Seattle, WA to conduct a Phase I Environmental Site Assessment (ESA) of property to be developed. This assessment revealed no evidence of environmental impairment within the Project area. Based on these findings, it is not anticipated that any environmental contamination will be encountered during construction or operation of the Project. In the unlikely event that contaminated soils are encountered, Applicant will coordinate with appropriate personnel at Department of Ecology.

3.1.5 Significant Unavoidable Adverse Impacts

There are no significant unavoidable adverse impacts related to geology, soils, erosion or topography.